Quantum Field Theory by Lewis H. Ryder, Cambridge University Press, 487 pages, Second Edition (1996).

D. V. Ahluwalia (Los Alamos National Laboratory).

The first edition of this book appeared in 1985. To my knowledge this was the the first book that presented a completely modern and logical development of quantum theory of matter and gauge fields. Since this book had very significant effect on my research, the review that follows carries the flavor of a personal note of thanks.

So in late eighties, when the first edition of this book reached my desk, I was a graduate student who had just finished taking some elementary courses in quantum mechanics and quantum field theory. I had not yet chosen a research topic. Professor Lewis H. Ryder's relatively slim book arrived my desk, and I, who was suffering from intense frustration created by the lack of a modern classic in quantum field theory, was immediately enamored by this work of scholarship.

The initial chapters of Professor Ryder's slim monograph guided me to the original works of Eugene Wigner, Steven Weinberg, C. N. Yang and R. L. Mills. Within a matter of a year or so I had expanded some of Professor Ryder's work and finished a over–two–hundred page Ph.D dissertation under my friend and mentor Professor Dave Ernst, a nuclear physicist who was at that time interested in high–spin hadronic resonances.

In the first chapter the reader is be introduced to the a "synopsis of particle physics," with the request, "I ask readers' indulgence to make the best they can of these sections until they meet explanations later in the book."

Chapter 2 is where the real fun begins. It is devoted to "single–particle relativistic wave equation." Here one need not depend on Dirac's genius to obtain the celebrated spin-1/2 wave equation for charged particles. Elegant and simple arguments based on classic works of Wigner, Weinberg, and his own teacher Feza Gürsey, are exploited to *derive* the celebrated Dirac equation. In the second edition the author had the opportunity to *correct* an important element that enters the derivation of Dirac equation. On. p. 41 (p.44 of the first edition) one is taught, "Now, when a particle is at rest, one cannot define its spin as either left–or right–handed, so $\phi_R(0) = \phi_L(0)$." This important observations should have been corrected, as I learned with C. Burgard, to read:

> Now, when a particle is at rest, one cannot define its spin as either left–or right–handed, so $\phi_R(0) = \pm\,\phi_L(0)$.

The $\pm$ sign is important for a consistent and correct derivation of the Dirac

equation and is responsible for the *opposite* relative intrinsic parities of spin–1/2 fermions. Its deeper significance arises when one considers spin one. For spin one, the same arguments (when corrected, as above) as that of Professor Ryder lead to a fundamentally new construct. Similarly, I wonder why after having so beautifully derived the Dirac equation, Professor Ryder chose not to present the derivation of the Maxwell equations as well. Within the framework of chapter 2, one could have easily obtained the Dirac spinors *without* any reference to Dirac equation. Again, this is not done and an opportunity is lost in showing the strength and beauty of Ryder's approach.

But these criticisms would not have even arisen had Professor Ryder not shown me the path on which these questions and my subsequent researches lay!

The free wave equations have no fire. The fire is breathed by demanding their covariance under appropriate gauge group. This is elegantly and logically done in Chapter 3.

The Chapter 2 and Chapter 3 provide the basic building blocks for a quantum theory of interacting matter and gauge fields. Chapter 4, as the logic demands, presents "canonical quantisation and particle interpretation." Chapter 5 is devoted to Richard Feynman's path integral approach. The Chapters 6 to 9 deal with the standard perturbative approach of quantum field theory, including an introduction to the standard model of electroweak interactions and renormalisation.

Chapter 10 and 11 are essentially self–contained essays on non-perturbative topological aspects and supersymmetry. On a recent weekend, looking at the fallen foot and half of snow in these mountains through a large glass window framed by pine trees in Los Alamos, I entertained myself with parts of these essays.

A rare combination of a thorough understanding and appreciation of the essential logical structure of quantum field theory and deep pedagogic skills have intermingled to create a masterpiece on the elementary introduction to quantum field theory in less than five hundred pages. My deepest thanks to Professor Ryder on behalf of all his readers. Without reservations, I give my strongest recommendation to every beginning student of physics to acquire and read *Quantum Field Theory* by L. H. Ryder.